OPERATING SUMMARY

WATER TREATMENT PLANTS

1967

ONTARIO WATER RESOURCES COMMISSION
Division of Plant Operations

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PREFACE

This summary of the operation of water treatment plants was prepared to facilitate the comparison of operating data for the various projects. A more complete summary of operating, design and historical data is available in the individual 1967 annual reports prepared for each of the following projects:

Bertie Twp., Dunnville, Fenelon Falls, Marmora, Meaford, Southampton, Goderich, and Union.

CONTENTS

LIST OF TABLES AND GRAPHS

PLANTS INCLUDED IN REPORT 1967

	SOLIDS (ALGAE & TURBIDITY) REMOVAL		DESIGN CAP. (MGD)	TREATMENT UNITS	RAW WATER SOURCE
1.	Bertie Twp.	6-0047-59	4.5	Microstrainer	Lake Erie
2.	Dunnville	6-0017-58	20.50	Microstrainer	Lake Erie
3.	Harrow	6-0004-57	1.25	Microstrainer	Lake Erie
4.	Fenelon Falls	6-0057-60	0.360	Sand filter (pres.)	Cameron Lake
5.	Meaford	6-0029-59	3.744	"Anthrafilt" filter (gravity)	Nottawasaga Bay
6.	Marmora	6-0025-58	0.216	D.E./Act. carbon filter (vac.)	Crow River
7.	Southampton	6-0124-63	1.000	D.E. filter (pres.)	Lake Huron
8.	Dresden	6-0007-57	0.500	"ACCELATOR" solids contact unit (coagulation & softening)	Sydenham River
9.	Eganville	6-0093-61	0.150	Alum coag; Sand filter (gravity)	Bonnechere River
10.	Lake Huron	5-001-64	37.00	Alum coag; Sand & anthracite filter (gravity)	Lake Huron
11.	Beaverton	6-0083-61	0.666	Alum & Act. Carb (No floc. tank) Clarifier; Sand filter (pres.)	Lake Simcoe
12.	Goderich	6-0069-60	1.50	Alum coag; Clarifier, Sand filter(gravity)	Lake Huron
13.	Warkworth	6-0148-65	0.100	Alum coag; Clarifier, Sand filter(gravity)	Mill Creek
14.	Union	6-0012-57	7.60	Microstrainer, Alum coag; Clarifier, Sand filter(gravity)	Lake Erie
	IRON REMOVAL				
15.	Brooklin	6-0053-59	0.216	Chlorination; Sand filter (pres.)	Well
16.	Fauquier Twp.	6-0078-61	0.072	Aeration; Sand filter (pres.)	Well
17.	Markham Twp.	6-0104-62	1.00	Aeration; Anthracite filter (pres.)	Well
18.	Mitchell	6-0042-59	0.720	Aeration "Anthrafilt" filter (pres.)	Well
	WATER SOFTENING (ALSO IRON REMOVAL)				
19.	Schomberg	6-0061-60	0.144	Sodium cation exchangers	Well
20.	Oak Ridges	6-0061-60	0.468	Zeolite units	Well
	SULPHIDE REMOVAL				
21.	Parkhill	6-0045-59	0.504	Chlorination & Aeration	Well

FLOW DATA

Flow data are summarized in Table No. I; as to average daily flow, maximum and minimum daily flows and where available, the maximum rate of flow.

The design capacities used were taken from OWRC reports summarizing the design details of the various plants. The capacity of the smallest treatment unit was used as the design capacity for the project.

The maximum average hydraulic loading occurred at Union where the average daily flow for the year was 55% of design capacity. The minimum average hydraulic loading was recorded at Warkworth, where the low flows in the first year of operation averaged 0.012 mgd, comprising 12% of the design capacity.

Maximum daily flows exceeded the design flow at Union and Markham Township. The flow of 8.409 mgd at Union was 111% of design capacity, and 1.054 mgd at Markham Township was 105% of design.

Figure No. 1 displays the average daily flow as a per cent of design flow for the various plants.

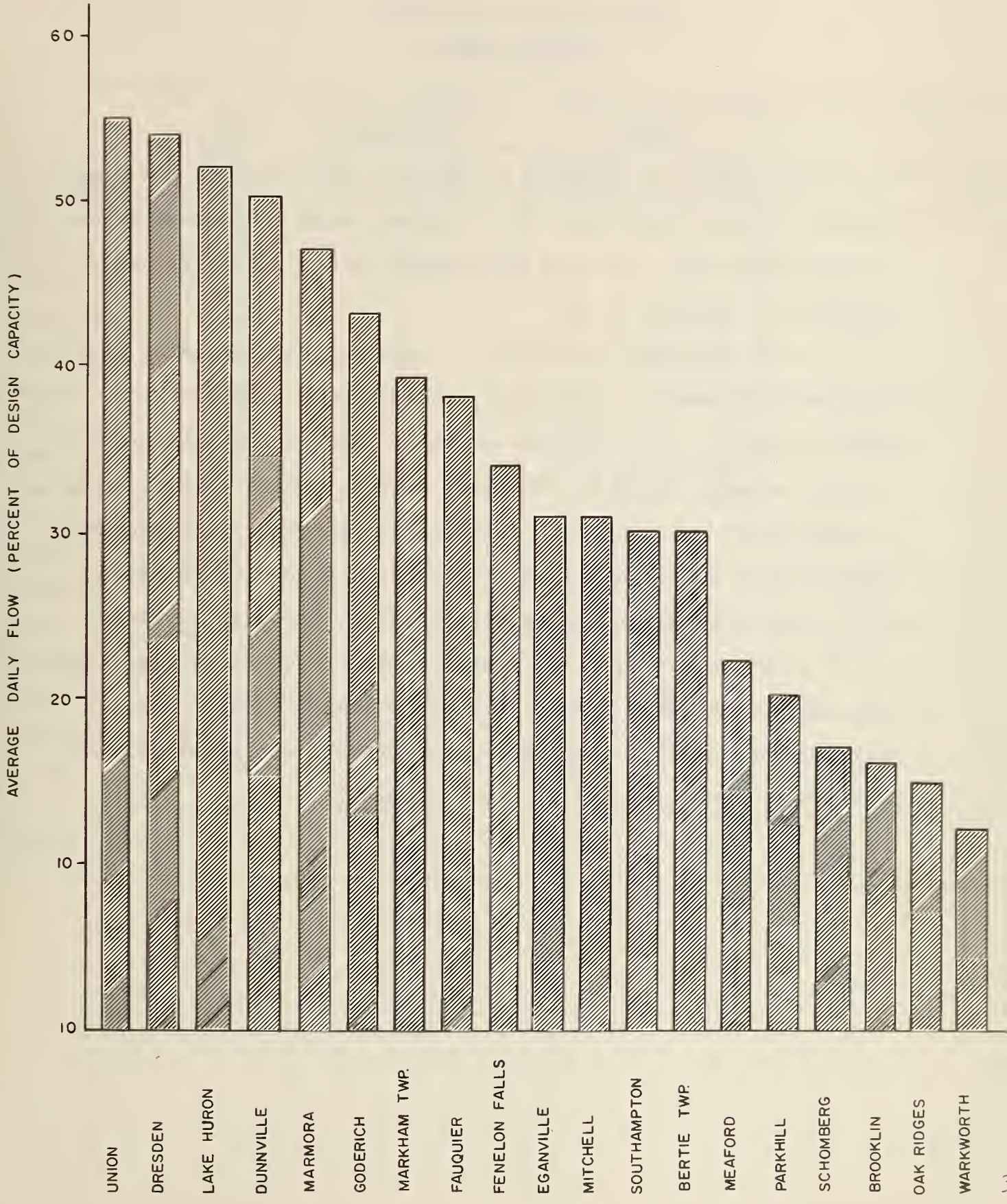
TABLE I

FLOWS

PROJECT	DESIGN CAP. MGD	AV. MGD	FLOW % OF DESIGN	MAX. DAY MGD	MIN. DAY MGD	MAX. RATE MGD
Bertie	4.50	1.388	30	2.895	0.750	4.968
Dunnville	20.50	10.175	50	14.740	5.808	-
Harrow	1.25	NOT AVAILABLE				
Fenelon Falls	0.36	0.123	34	0.283	0.068	-
Meaford	3.744	0.828	22	1.201	0.446	1.584
Marmora	0.216	0.102	47	0.164	0.051	-
Southampton	1.000	0.300	30	0.827	0.169	-
Dresden	0.50	0.271	54	0.458	0.147	-
Eganville	0.150	0.047	31	0.121	0.004	-
Lake Huron	37.0	19.25	52	28.4	11.0	37.0
Beaverton	0.685	NOT AVAILABLE				
Goderich	1.500	0.644	43	1.333	0.405	2.60
Warkworth	0.100	0.012	12	0.041	0.004	-
Union	7.60	4.203	55	8.409	1.331	10.800
Brooklin	0.216	0.034	16	0.130	0.006	-
Fauquier	0.072	0.027	38	0.050	0.017	-
Markham Twp.	1.00	0.385	39	1.054	0.112	-
Mitchell	0.720	0.225	31	0.436	0.088	-
Schomberg	0.144	0.025	17	0.092	0.004	-
Oak Ridges	0.468	0.071	15	0.205	0.017	-
Parkhill	0.504	0.099	20	0.134	0.074	-

FIGURE No. 1

FLOW AS A PER CENT
OF DESIGN CAPACITY



PROCESS WATER

The recorded quantity of process water used at the plant does not include water used for building clean-up, lawn-watering, or other such uses, but only that required for the continued operation of process units.

From the data available, it appears that the water used by micro-strainers is negligible, amounting to 0.029% of the output at Union. The quantity of water used in backwashing filters averaged 2.82% of the plant output. There appears to be no significant difference in this respect between diatomaceous earth filters and sand filters. The large amount of backwash water used at Goderich can be attributed to the high turbidity of the water being filtered, necessitating frequent backwashing. Conversely, the small amount of backwash water used at Fenelon Falls, amounting to 1.6% of the plant output, can be attributed to the very low turbidity of the raw water.

TABLE II

IN-PLANT USE OF PROCESSED WATER

PROJECT	TOTAL PLANT FLOW MG	WATER USED: MICRO-STRAINER (JET WASH) MG	MICRO-STRAINER (JET WASH) % OF OUT-PUT	FILTER (BACKWASH) NO. OF BACK-WASHES	FILTER (BACKWASH) MG	FILTER (BACKWASH) % OF OUT-PUT	TOTAL USED MG	% OF OUTPUT
Bertie	506.222	NOT AVAILABLE		-	-	-	-	-
Dunnville	3714.052	NOT AVAILABLE		-	-	-	-	-
Harrow	N O T A V A I L A B L E			-	-	-	-	-
Fenelon Falls	44.771	-	-	239	0.731	1.6	0.731	1.6
Meaford	302.046	-	-	121	7.986	2.6	7.986	2.6
Marmora	33.724	-	-	98	NOT AVAILABLE		(WASHED WITH HOSE)	
Southampton	109.494	-	-	240	2.40	2.2	2.40	2.2
Eganville	17.148	-	-	110	NOT AVAILABLE		-	-
Lake Huron	2696.1	-	-	-	104.3	3.9	104.3	3.9
Beaverton	N O T A V A I L A B L E							
Goderich	235.314	-	-	540	11.684	5.0	11.684	5.0
Warkworth	3.685	-	-	113	0.080	2.5	0.080	2.5
Union	1534.236	0.433	0.029	703	39.376	2.6	39.809	2.6
Brooklin	12.266	-	-	N O T AVAILABLE			-	-
Fauquier	10.009	-	-	160	NOT AVAILABLE		-	-
Markham Twp.	136.579	-	-	N O T AVAILABLE			-	-
Mitchell	82.085	-	-	88	1.75	2.1	1.75	2.1
AVERAGE	-	-	0.029	-	-	2.82	-	2.82

TURBIDITY REMOVAL

Turbidities expressed as Jackson Turbidity Units (J.T.U.) have, for the most part, been determined using Hellige Turbidimeters. Southampton is equipped with on-line Bowser Automatic Turbidimeters, which are periodically checked against Hellige values.

Table No. III summarizes Turbidity data for the projects designed for solids removal. Aside from the projects for which no operation data is available, two projects, Marmora and Warkworth, of the twelve designed for solids and turbidity removal, do not employ turbidity determinations in process control.

The reduction of turbidity by micro-strainers averaged 8.4%. Since the purpose of micro-strainers is the removal of algae and other gross particles, (and since algae enumeration is not routinely carried out on both raw and treated water), the effectiveness of micro-strainers as treatment units cannot be evaluated.

Alum flocculation, followed by sedimentation, yielded an average reduction in turbidity of 88%.

Excluding Fenelon Falls, with no reduction in turbidity, the average reduction due to filtration was 82%.

TABLE III

TURBIDITY

PROJECT	RAW		MICRO-STRAINED			CLARIFIED			FILTERED			FINAL	
	AV. (JTU)	MAX. REC. (JTU)	AV. (JTU)	MAX. (JTU)	REDN. AV. %	AV. (JTU)	MAX. (JTU)	REDN. AV. %	AV. (JTU)	MAX. (JTU)	REDN. AV. %	AV. (JTU)	REDN. AV. %
Bertie	5.3	15.3	4.4	13.4	17							4.4	17
Dunnville	15.1	128.0	14.4	124.0	4.6							14.4	4.6
Harrow	NOT AVAILABLE												
Fenelon Falls	0.5	0.5							0.5	0.5	-	0.5	-
Meaford	2.6	65.0							1.1	25.0	58	1.1	58
Marmora	NOT RECORDED												
Southampton	8.1	65.0							0.5	15	94	0.5	94
Dresden	204	1500				2.6	8	99				2.6	99
Beaverton	NOT AVAILABLE												
Lake Huron	9.2	78.0							0.77	1.70	92	0.77	92
Goderich	16.8	343.5				4.0	12.0	76	0.9	2.3	78	0.9	95
Warkworth	NOT RECORDED												
Union	19.4	96.0	18.7	96.0	3.6	1.8	60.0	90.0	0.2	4.2	89	0.2	99
AVERAGE REMOVAL (%)					8.4			88.0			82.2		

Note: The % reduction in turbidity was not considered in the case of Fenelon Falls because of the high quality of the raw water.

WATER QUALITY

Table No. IV is a summary of the average water quality during the year. In most cases, the analyses were performed at the OWRC laboratory. Those results marked with asterisks (*) include analyses done at the plant on a daily routine basis.

There were no samples submitted for chemical analysis from Meaford, and only raw water samples from Union. Of the three projects providing micro-straining, only Dunnville recorded algae counts. Parkhill, designed primarily for sulphide removal, recorded no analyses for sulphides.

TABLE IV

WATER QUALITY (CHEMICAL)

PROJECT	HARDNESS (ppm $CaCO_3$) RAW	HARDNESS (ppm $CaCO_3$) TREATED	ALKALINITY (ppm $CaCO_3$) RAW	ALKALINITY (ppm $CaCO_3$) TREATED	IRON (ppm Fe) RAW	IRON (ppm Fe) TREATED	COLOUR (App. Colour Units) RAW	COLOUR (App. Colour Units) TREATED	CHLORIDE (ppm Cl^-) RAW	CHLORIDE (ppm Cl^-) TREATED	ALGAE (SAU per ml) RAW	ALGAE (SAU per ml) TREATED
Bertie	138	138	102	100	0.22	0.17	7	7	27	27		
Dunnville	151	153	111	111	0.85	0.82	6	6	27	28	540	
Harrow	114	106	87	79	0.20	0.19	<5	<5	25	30		
Fenelon Falls	62	60	52	45	0.20	0.15	28	14	3	6		
Meaford												
Marmora	90	92	75	71	0.16	0.14	31	21	4	6		
Southampton	115	124	95	99	0.56	0.08	7	<5	6	7		
Dresden b	264*	135*	193	43	0.92	0.12	35	<5	16	17		
Eganville	50	50	41	38	0.09	0.10	25	20	3	4		
Lake Huron		106		80		0.13		<5		7		
Beaverton	134	136	114	115	0.15	0.11	10	10	9	11		
Goderich	106	110	87	84	0.45	0.11	5	<5	11	11	774	238**
Warkworth	223	217	206	200	0.19	0.11	27*	15*	4	6		
Union	122		88		1.21		16		23			
Brooklin a	262	260	94	94	1.0 *	0.3 *			5	7		
Fauquier a					1.3 *	0.2 *						
Markham a	366	334	300	282	0.56	0.44			41	44		
Mitchell a	252	248	203	200	0.6 *	0.1 *			6	6		
Schomberg b	250	155	313	332	1.31	2.69			1	9		
Oak Ridges b	252	118	253	260	1.13	0.48						
Parkhill c					0.13	1.77			176	193		

a Iron Removal Plants
b Softening Plants
c Sulphide Removal

* Includes In-Plant Analyses Performed Daily
** Settled Water Prior to Filtration

PROCESS CHEMICALS

The usage of process chemicals, other than chlorine for pre-chlorination, is summarized in Table No. V. The total quantity used and the dosage per million gallons of water processed is listed.

Alum quantities were reported in various units; Dresden as 389 fifty pound bags; Warkworth as 3,396 gallons of 12% w/v solution; and the remainder as gallons of 22.2% solution. These are converted, for purposes of comparison, to volume of 22.2% alum solution. Warkworth had an unusually high alum dosage due to difficulty in maintaining the very low feed rate caused by the low first year water demand as compared to the plant design capacity.

Activated carbon was used only occasionally at both Marmora and Union, during periods when the raw water was highly coloured. The dosages recorded in the table are based on flows when activated carbon was used, rather than the total annual flow. At Marmora, 146 pounds of activated carbon was used to treat 3.716 million gallons, and at Union, 1,650 pounds was used to treat 62.943 million gallons.

Saturated brine was used at Schomberg and Oak Ridges to regenerate the softening (ion exchange) units.

TABLE V

PROCESS CHEMICALS

PROJECT	TOTAL FLOW MG	LIME		ALUM		ACT. CARBON		DIATOMACEOUS EARTH		SATURATED BRINE	
		LB.	LB. PER MG	GAL.	GAL. PER MG	LB.	LB. PER MG	LB.	LB. PER MG	GAL.	GAL. PER MG
Marmora	33.724					146	39.4	8990	266		
Southampton	109.494							79050	722		
Beaverton	N O T	A V A I		L A	B L E						
Dresden	98.825	164350	1640	8750	88.5						
Eganville	17.148			1450	84.5						
Lake Huron	2696.1			43879	16.3						
Goderich	235.314			6071	26.6						
Warkworth	3.685			2230	606.						
Union	15 34.236			40206	26.2	1650	26.3				
Schomberg	9.142									22814	2500
Oak Ridges	25.872									50051	1935

CHLORINATION AND DISINFECTION

Table No. VI summarizes the use of chlorine both in the treatment process and for disinfection. Eganville, Warkworth, and Fauquier, employed hypochlorite solutions during the year; Eganville using 1,608 gallons; Warkworth 62 gallons; and Fauquier 210 gallons. For purposes of comparison, the liquid measures were converted to pounds of available chlorine, assuming a 12% solution. Chlorination records for Brooklin are available only to the end of July.

In order to provide an indication of the effectiveness of disinfection, the total number of samples of treated water submitted for analysis and the number of samples containing coliform bacteria are listed in the same table. In general, an orthotolidine residual of 0.5 ppm is maintained in water leaving the plant. The number of bacteriological samples taken as shown in the table do not include samples analyzed at Department of Health Laboratories.

At Parkhill, chlorine is added to the water leaving the plant in order to oxidize sulphides remaining after aeration. While oxidation of sulphides is the primary purpose of chlorination, disinfection is also effected.

TABLE VI

CHLORINATION & DISINFECTION

PROJECT	TOTAL FLOW MG	PRECHLOR. LBS. CHLORINE USED	POST CHLOR. LBS. CHLORINE USED	TOTAL USED LBS.	DOSAGE (TOTAL) PPM	COLIFORMS) (TREATED WATER) NO. OF SAMPLES TAKEN	COLIFORMS) (TREATED WATER) NO. WITH COUNT MORE THAN O.
Bertie	506.222		5581	5581	1.1	85	0
Dunnville	3714.052		37470	37470	1.0	149	5
Harrow						141	3
Fenelon Falls	44.771		1086	1086	2.4	87	4
Meaford	302.046		2841	2841	0.9	143	1
Marmora	33.724		797	797	2.4	18	0
Southampton	109.494		1256	1256	1.2	22	0
Dresden	98.825		2393	2393	2.4	0	
Leanville	17.148		1930	1930	11.3	0	
Lake Huron	2696.1	13636 (60 Days)	17453 (82 Days)	31089	1.2	469	4
Beaverton						30	0
Goderich	235.314	2583	354	2937	1.3	229	1
Warkworth	3.685	403	343	746	20.2	48	0
Union	1534.236	35154	11732	46887	3.1	N O T	R E C O R D E D
Brooklin	12.266					18	2
Fauquier	10.009			250	2.5	62	0
Markham Twp.	136.579	N O T	A V A I L A B L E			123	12
Mitchell	82.085	N O T	A V A I L A B L E			104	1
Schomberg	9.142	N O T	A V A I L A B L E			57	4
Oak Ridges	25.872	N O T	A V A I L A B L E			6	0
Parkhill	36.325			4935	13.5	138	9

OPERATING COSTS

The cost of operation of the water treatment plants used in this report include payroll of staff employed at the plants, fuel, power, chemicals, general supplies, equipment, repairs and maintenance, sundry, water, and travel. The cost of head office supervision, including travel, accounting, purchasing, and inspection, is not charged against the project.

An explanation of items included in each of the categories of the operating costs follows:

1. Payroll
   - Regular: Staff salaries, including pension, medical plan, and Workmen's Compensation payments.
   - Casual: Salaries of labour employed on a temporary or part-time basis during staff shortages; or for part-time work. Workmen's Compensation payments are also included.
2. Fuel - Includes fuel oil, natural gas or propane used for heating.
3. Power - Includes hydro-electric power; and natural gas, gasoline, diesel fuel, if used for power generators.
4. Chemicals - Includes chlorine, sodium hypochlorite, diatomaceous earth, hydrated lime, alum, activated carbon and salt.

5. General Supplies - Includes laboratory reagents, laboratory equipment replacement, cleaning materials, lubricants, stationery, uniforms, light bulbs, instrument charts, books, etc.

6. Equipment - Includes equipment to be used in the treatment process, laboratory, building, grounds, maintenance, and small tools.

7. Repairs & Maintenance - Includes goods and services (excluding OWRC staff) used in the repair and maintenance of process, electrical equipment and buildings, inspections, packing materials, paints, etc.

8. Sundry - Includes express charges, telephone, telemetering, insurance, taxes, etc.

9. Water - Includes all charges for water.

10. Travel - Includes operators travel to local hardware stores, railroad stations, conferences, conventions, etc. The cost of accommodation and meals associated with conferences and conventions is also included.

Table No. VII lists the total annual operating costs for each project under the categories described above.

Table No. VIII summarizes total operating, labour, both regular and casual staff, power, chemical, and repair and maintenance costs as percentages of the total operating cost and as the cost per thousand gallons processed. Both the Meaford and Southampton projects were staffed by PUC personnel and itemized invoices for services were available only for Southampton. The operating expenditures, in many cases, do not reflect the true cost of operation since the municipalities absorbed part of the cost of operation, the extreme case being Mitchell, where the total recorded expenditure consisted of insurance premium payments. Warkworth, in its first year of operation, utilized only a small part of its capacity, and hence yielded an inordinately high unit cost of 63.6¢ per thousand gallons.

Figure No. 2 displays the unit costs of treatment in cents per thousand gallons; the plants being ranked in order of decreasing costs.

TABLE VII

OPERATING COSTS (TOTAL)

PROJECT	SALARIES-REG.	SALARIES-CAS.	FUEL	POWER	CHEMICALS	GEN.SUP.	EQUPT.	R & M	SUNDRY	WATER	TRAVEL	TOTAL
Bertie	26,549.21	1977.33	988.74	11,613.31	966.68	924.29	700.03	1571.95	1,001.11		581.32	46,873.97
Dunnville	42,941.86	1580.53	906.46	37,137.71	3,025.06	2625.19	4034.09	4620.12	7,825.21	C r. (74.40)	758.17	105,380.00
Harrow						27.30		25.84	202.98			256.12
Fenelon Falls	5,033.26	572.31			106.13	406.17	292.50	221.80	621.51		273.54	7,527.22
Meaford						63.07		363.49	14,294.37*			14,294.37
Marmora				920.05	22.50	3.65		18.47	187.18			1,151.85
Southampton					8,286.86	225.79	610.03	1244.83	7,275.09*		42.00	17,684.60
Dresden								177.54	212.89			390.43
Beaverton							46.25	56.45	118.05			220.75
Eganville					466.88	49.00	66.21	15.00	72.92			670.01
Lake Huron	59,534.26	2746.24	84.75	71,298.59	17,888.65	1903.74	17192.55	4309.04	10,408.65		5801.31	191,167.78
Goderich	27,735.80	2705.58		5,412.25	1,108.63	878.20	238.97	1187.50	7,725.41		499.93	47,492.27
Warkworth		1345.59		529.79	141.20	150.13	73.31		103.10			2,343.12
Union	61,902.86		2985.89	24,005.96	13,488.58	4184.95	422.55	5321.25	15,931.68		2105.64	130,349.36
Brooklin		1719.50		899.96	240.00	17.50	9.00	84.40	62.51			3,032.88
Fauquier		1266.67		1323.22	50.00	112.19		89.69	87.09			2,928.86
Markham	14,893.83	907.15	556.29	9962.05	496.20	824.86	627.15	392.02	1,488.33		1088.62	31,236.50
Mitchell									100.95			100.95
Schomberg		1348.26		1491.07	893.96	15.44	59.80	616.11	115.59			4,540.23
Oak Ridges	85.51	1251.32		746.42	477.94	206.13		819.29	137.99		21.00	3,745.60
Parkhill					649.69	161.22		681.98	1224.05			2,716.94

* Sundry includes power and labour

TABLE VIII

OPERATING COSTS

PROJECT	TOTAL OPERATING COSTS		LABOUR (REGULAR & CASUAL)			POWER COSTS			CHEMICAL COSTS			REPAIR & MAINT.		
	TOTAL ($)	¢ PER 1000 GAL.	TOTAL ($)	% OF TOTAL	¢ PER 1000 GAL.	TOTAL ($)	% OF TOTAL	¢ PER 1000 GAL.	TOTAL ($)	% OF TOTAL	¢ PER 1000 GAL	TOTAL ($)	% OF TOTAL	¢ PER 1000 GAL.
1. Entire Operating Cost Charged to Project														
Bertie	46,873.97	9.23	28,526.54	61.0	5.64	11,613.31	24.8	2.30	966.68	2.1	0.19	1571.95	3.4	0.31
Brooklin	3,032.88	24.65	1,719.50	56.6	13.95	899.96	29.6	7.31	240.00	7.9	1.95	84.40	2.8	0.69
Dunnville	105,380.00	2.84	44,522.39	42.5	1.20	37,137.71	35.2	1.00	3025.06	2.9	0.08	4620.12	4.4	0.12
Fauquier	2,928.86	29.29	1,266.67	43.2	12.67	1,323.22	45.2	13.23	50.00	1.7	0.50	89.69	3.1	0.90
Goderich	47,492.27	20.20	30,441.38	64.2	12.95	5,412.25	11.4	2.31	1108.63	2.3	0.47	1187.50	2.5	0.50
Lake Huron	191,167.78	7.13	62,280.50	32.6	2.31	71,298.59	41,0	2.65	17888.65	9.3	0.66	4309.04	2.3	0.16
Markham Twp.	31,236.50	22.98	15,800.98	50.5	11.62	9,962.05	31.9	7.33	496.20	1.6	0.37	369.02	1.2	0.27
Meaford	14,294.37	4.73										363.49	2.5	0.12
Oak Ridges	3,745.60	14.97	1,336.83	35.7	5.34	746.42	19.9	2.99	477.94	12.7	1.91	819.29	21.9	3.27
Schomberg	4,540.23	49.70	1,348.26	29.7	14.76	1,491.07	32.8	16.35	893.96	19.7	9.78	616.11	13.5	6.75
Southampton	17,684.60	16.20	2,560.00	14.5	2.35	2,596.12	15.2	2.37	8286.86	46.9	7.59	1244.83	7.0	1.14
Union	130,349.36	8.48	61,902.86	47.5	4.03	24,005.96	18.5	1.56	13488.58	10.4	0.88	5321.25	4.1	0.35
Warkworth	2,343.12	63.60	1,345.59	57.4	36.45	529.79	22.5	14.34	141.20	6.0	3.83			
2. Partial Costs Only Available														
Beaverton	220.75											56.45	25.2	
Dresden	390.43	0.39										177.54	45.3	0.18
Eganville	670.01	3.92							466.88	69.6	2.73	15.00	2.2	0.09
Fenelon Falls	7,527.22	1.68	5,605.57	74.8	1.26				106.13	1.4	0.24	221.80	2.9	0.49
Harrow	256.12											25.84	10.0	
Marmora	1,151.85	3.42				920.05	79.9	2.73	22.50	1.9	0.07	18.47	1.6	0.06
Mitchell	100.95	0.12												
Parkhill	2,716.94	7.49							649.69	23.9	1.79	681.98	25.1	1.87

FIGURE No. 2

OPERATING COSTS
(¢ PER 1000 GAL.)

OPERATING STAFF

Eleven plants recorded labour charged to the project, six of which were operated by permanent employees, five by part-time staff. Operating personnel for the remainder of the projects were provided by the municipalities. The number of casual and part-time staff in Table No. IX is reported to the nearest one-tenth of a man-year.

Of the six plants employing full-time operators, Bertie, Dunnville, Goderich, and Union, were staffed 24 hours per day while Fenelon Falls and Markham Twp. were staffed 8 hours per day.

There is insufficient data available to derive any relationship between staff complement and plant size. However, it may be noted that Bertie and Dunnville, having microstrainers only, required relatively small staffs, averaging 1.2 and 0.4 men/mgd respectively, and that the staff requirement per mgd decreases with increasing plant size. The latter effect is more pronounced in the comparison of Goderich and Union, in which Goderich, with a design capacity of 1.5 mgd, employed 3.3 men/mgd, while Union, with a design capacity of 7.6 mgd, employed 1.3 men/mgd.

TABLE IX

OPERATING STAFF

PROJECT	SUPERINTENDENT	ASSISTANT SUPERINTENDENT	CHIEF OPERATOR	ASSISTANT CHIEF OPERATOR	MECHANIC	OPERATOR	ELECTRICIAN	CONTROL TECHNICIAN	LABOURER	GROUNDSMAN/ JANITOR	CASUAL/ PART-TIME	TOTAL	DESIGN CAPACITY MGD	NO. OF MEN PER MGD DESIGN
Bertie			1		1	3					0.5	5.5	4.50	1.2
Dunnville	1	1*				5					0.4	7.4	20.50	0.4
Fenelon Falls			1								0.2	1.2	0.36	3.3
Southampton											0.8	0.8	1.00	0.8
Goderich			1	1		3					0.9	4.9	1.50	3.3
Warkworth											0.5	0.5	0.100	5.0
Union	1	1**			1	5				2		10.0	7.60	1.3
Brooklin											0.5	0.5	0.22	2.0
Fauquier											0.6	0.6	0.07	8.0
Markham Twp.			1			1					0.2	2.2	1.00	2.2
Schomberg											0.4	0.4	0.144	3.0
Oak Ridges											0.4	0.4	0.468	1.0
Lake Huron	1				1	10	1	1	2			16.0	37.0	0.4

* Assistant Superintendent is the plant mechanic

** Assistant Superintendent is the plant electrician


ONTARIO WATER RESOURCES COMMISSION